eVTOL Simulation Problem

Objective

Show us your awesome skills! We want to see your design, coding, documentation, testing, and communication abilties first hand!

Details

*This work must be coded in **C++,** and submitted through GitHub, BitBucket, or Gitlab. Upload the documented code to your personal account and send us a link. We may look at the git history to see how you use version control.*

At Joby we love good OOP design. Please exercise the basic tenants of OOP, using relevant principles where appropriate. We're looking for robust, testable, modular, and well-documented code.

Unit Testing is a big part of our development process. Please include just a few examples of unit tests or how your code is testable. Tests don't necessarily need to run in any test framework, but please be ready to talk about what and how you tested your code.

Todos and notes are OK. If you want to incorporate an idea that makes sense in a real project, but would take too much time to implement, just leave a note. For example:

// Todo: Refactor database to use hashmap rather than raw array for
// <xyz> reasons..

Problem Statement

There are five companies developing eVTOL aircraft. The vehicle produced by each manufacturer has different characteristics. Six distinct properties are laid out in the below table:

Company Name	*Alpha Company*	*Bravo Company*	*Charlie Company*	*Delta Company*	*Echo Company*
Cruise Speed (mph)	*120*	*100*	*160*	*90*	*30*
Battery Capacity (kWh)	*320*	*100*	*220*	*120*	*150*
Time to Charge (hours)	*0.6*	*0.2*	*0.8*	*0.62*	*0.3*
Energy use at Cruise (kWh/mile)	*1.6*	*1.5*	*2.2*	*0.8*	*5.8*
Passenger Count	*4*	*5*	*3*	*2*	*2*
Probability of fault per hour	*0.25*	*0.10*	*.05*	*.22*	*.61*

You will simulate using these vehicle for 3 hours. Of course your simulation should take much less time than that. 20 total vehicles should be deployed, and a random number of each type of vehicle should be used (with the total between all five types being 20).

There are only three chargers available for all 20 vehicles! A single charger can only be used by one vehicle at a time. Assume the chargers can charge the batteries in the Time to Charge time listed for each vehicle.

Keep track of the following statistics per vehicle type:
- average flight time per flight
- average distance traveled per flight
- average time charging per charge session
- total number of faults
- total number of passenger miles.

*For example, if there are 2 vehicles carrying 4 passengers on a vehicle that cruises for 1 hour at 100 mph, total number of passenger miles is 2 * 4 * 1 * 100 = 800.*

Assume that:
- Each vehicle starts the simulation with a fully-charged battery
- Each vehicle instantaneously reaches Cruise Speed
- Each vehicle is airborne for the full use of the battery, and is immediately in line for the charger after running out of battery power.

Please include the statistics recorded during at least one run of the simulation in your submission.

Please do not hesitate to reach out to ask any questions about the problem! However, if you find yourself making an assumption that we haven't explained explicitly, you may simply document your assumption. It's interesting to us to hear what assumptions you made and why.

Andrew Louder Notes:
Andy's email question:
Thanks for the questions!

For the case of the fault, we purposefully don't specify whether or not it's a fault that would end the flight. You can decide to act on faults any way you see fit. In either case, each plane must fully recharge between landing and taking off again.

Regarding passengers, these are good questions! For the sake of simplicity, I would personally just use a single hub location with 3 chargers. This is your "sightseer" example where all flights begin and end in the same location.

If you chose to go with a different assumption that is fine! As a reminder, the purpose of the coding challenge is to showcase your coding skills, so variations on the problem statement itself are fine. Just maintain the core of the problem, and document any assumptions you make.

We're looking forward to seeing your submission!
Carl's notes:
Thanks for the questions!

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More notes.
Now going with a sighteer passenger application.

- A sightseer evtol vehicle mission will start at a rate of one per minute.
- A mission will randomize between 1 and the maximum vehicle passenger count(5).